

**DRAFT FINAL
EXPANDED ENGINEERING EVALUATION/COST ANALYSIS (EEE/CA)
FOR THE
McLAREN TAILINGS SITE
COOKE CITY, MONTANA**

Engineering Services Agreement DEQ/MWCB 401027
Task Order Number 05

Prepared for:

Mr. John Koerth
Montana Department of Environmental Quality
Mine Waste Cleanup Bureau
P. O. Box 200901
Helena, Montana 59620

Prepared by:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

May 2002

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION.....	1-1
1.1 REPORT ORGANIZATION	1-3
2.0 SITE BACKGROUND	2-1
2.1 MINING HISTORY	2-1
2.2 CLIMATE.....	2-2
2.3 GEOLOGY, HYDROGEOLOGY, AND HYDROLOGY	2-3
2.3.1 Regional Geologic Setting	2-4
2.3.2 Local Geologic Setting.....	2-4
2.3.3 Hydrogeologic Setting	2-4
2.3.4 Seismotectonic Setting and History	2-5
2.3.5 Surface Water Hydrology.....	2-5
2.4 CURRENT SITE SETTING.....	2-6
2.4.1 Location and Topography	2-6
2.4.2 Vegetation, Wildlife & Fisheries	2-6
2.4.3 Historic or Archaeologically Significant Features	2-7
2.4.4 Land Use and Population	2-7
3.0 WASTE CHARACTERISTICS AND SUMMARY OF EXISTING SITE DATA	3-1
3.1 BACKGROUND SOIL SAMPLES.....	3-2
3.2 MINE/MILL WASTE SOURCES	3-3
3.2.1 Waste Rock Dump	3-3
3.2.2 Tailings Impoundment	3-4
3.3 TAILINGS DAM	3-5
3.3.1 Old Stream Channel.....	3-5
3.3.2 Potential Repository/Cover Soil Borrow Areas	3-6
3.4 SURFACE WATER AND SEDIMENT CHARACTERISTICS	3-6
3.4.1 Surface Water Chemistry Results	3-6
3.4.2 Surface Water Loading Analysis.....	3-7
3.4.3 Stream Sediment Chemistry Results.....	3-8
3.5 GROUNDWATER	3-9
4.0 SUMMARY OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS.....	4-1
5.0 BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS.....	5-1
5.1 HUMAN HEALTH RISK ASSESSMENTS.....	5-1
5.1.1 Hazard Identification.....	5-1
5.1.2 Exposure Scenarios	5-1
5.1.3 Toxicity Assessment	5-2
5.1.4 Risk Characterization.....	5-3
5.2 ECOLOGICAL RISK ASSESSMENT.....	5-5
5.2.1 Introduction.....	5-5

5.2.2	Contaminants and Receptors of Concern.....	5-6
5.2.3	Exposure Assessment.....	5-6
5.2.4	Ecological Effects Assessment	5-7
5.2.5	Risk Characterization.....	5-9
5.2.6	Risk Characterization Summary	5-11
6.0	RECLAMATION OBJECTIVES AND GOALS	6-1
6.1	ARAR-BASED RECLAMATION GOALS.....	6-1
6.1.1	Surface Water.....	6-1
6.1.2	Groundwater	6-1
6.1.3	Soil	6-1
6.2	RISK-BASED CLEAN UP GOALS	6-1
7.0	DEVELOPMENT AND SCREENING OF RECLAMATION ALTERNATIVES	7-1
7.1	IDENTIFICATION AND SCREENING OF RECLAMATION ALTERNATIVES	7-1
7.1.1	No Action.....	7-3
7.1.2	Institutional Controls	7-3
7.1.3	Engineering Controls	7-3
7.1.3.1	Containment.....	7-3
7.1.3.2	Surface Controls	7-4
7.1.3.3	Off-Site Disposal	7-5
7.1.3.4	Excavation and Treatment	7-5
7.1.3.5	Fixation/Stabilization.....	7-5
7.1.3.6	Reprocessing.....	7-5
7.1.3.7	Physical/Chemical Treatment	7-6
7.1.3.8	Thermal Treatment	7-6
7.1.4	<i>In-situ</i> Treatment.....	7-7
7.1.4.1	Physical/Chemical Treatment	7-7
7.1.4.2	Thermal Treatment	7-7
7.2	SITE-SPECIFIC ALTERNATIVES	7-8
7.3	PRELIMINARY EVALUATION AND SCREENING OF ALTERNATIVES	7-8
7.3.1	Alternative 1: No Action.....	7-9
7.3.2	Alternative 2: Institutional Controls	7-10
7.3.3	Alternative 3: In-Place Containment.....	7-10
7.3.4	Alternative 4: Partial Removal and In-Place Containment.....	7-13
7.3.5	Alternative 5a: On-Site Disposal in a Fully Encapsulated Repository	7-17
7.3.6	Alternative 5b: On-Site Disposal in an Un-Lined Repository with a Multi-Layered Cap	7-21
7.3.7	Alternative 5c: On-Site Disposal in a Constructed Repository with a Soil Cover	7-26
7.3.8	Alternative 6: Off-Site Disposal in a Nearby Mine Waste Repository	7-30
7.3.9	Alternative 7: Off-Site Disposal in a Montana Class II Landfill	7-33
7.4	SUMMARY OF ALTERNATIVE SCREENING.....	7-36
8.0	DETAILED ANALYSIS OF RECLAMATION ALTERNATIVES.....	8-1

8.1	QUANTITATIVE EVALUATION OF THRESHOLD CRITERIA	8-4
8.2	ALTERNATIVE 1: NO ACTION	8-6
	8.2.1 Overall Protection of Human Health and the Environment.....	8-6
	8.2.2 Compliance with ARARs	8-7
	8.2.3 Long-Term Effectiveness and Permanence.....	8-8
	8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment	8-8
	8.2.5 Short-Term Effectiveness	8-8
	8.2.6 Implementability	8-8
	8.2.7 Costs	8-9
8.3	ALTERNATIVE 4: PARTIAL REMOVAL AND IN-PLACE CONTAINMENT	8-9
	8.3.1 Overall Protection of Human Health and the Environment.....	8-9
	8.3.2 Compliance with ARARs	8-10
	8.3.3 Long-Term Effectiveness and Permanence.....	8-10
	8.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment	8-11
	8.3.5 Short-Term Effectiveness	8-12
	8.3.6 Implementability	8-13
	8.3.7 Costs	8-13
8.4	ALTERNATIVE 5A: ON-SITE DISPOSAL IN A FULLY ENCAPSULATED REPOSITORY	8-13
	8.4.1 Overall Protection of Human Health and the Environment.....	8-13
	8.4.2 Compliance with ARARs	8-14
	8.4.3 Long-Term Effectiveness and Permanence.....	8-15
	8.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment	8-16
	8.4.5 Short-Term Effectiveness	8-16
	8.4.6 Implementability	8-17
	8.4.7 Costs	8-17
8.5	ALTERNATIVE 5B: ON-SITE DISPOSAL IN AN UN-LINED REPOSITORY WITH A MULTI-LAYERED CAP	8-18
	8.5.1 Overall Protection of Human Health and the Environment.....	8-18
	8.5.2 Compliance with ARARs	8-19
	8.5.3 Long-Term Effectiveness and Permanence.....	8-20
	8.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment	8-20
	8.5.5 Short-Term Effectiveness	8-21
	8.5.6 Implementability	8-21
	8.5.7 Costs	8-22
8.6	ALTERNATIVE 5C: ON-SITE DISPOSAL IN A CONSTRUCTED REPOSITORY WITH A SOIL COVER	8-22
	8.6.1 Overall Protection of Human Health and the Environment.....	8-22
	8.6.2 Compliance with ARARs	8-23
	8.6.3 Long-Term Effectiveness and Permanence.....	8-24
	8.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment	8-24
	8.6.5 Short-Term Effectiveness	8-25
	8.6.6 Implementability	8-26
	8.6.7 Costs	8-26

8.7	ALTERNATIVE 6: OFF-SITE DISPOSAL IN A NEARBY MINE WASTE REPOSITORY	8-26
8.7.1	Overall Protection of Human Health and the Environment.....	8-27
8.7.2	Compliance with ARARs	8-28
8.7.3	Long-Term Effectiveness and Permanence.....	8-29
8.7.4	Reduction of Toxicity, Mobility, or Volume Through Treatment	8-29
8.7.5	Short-Term Effectiveness	8-29
8.7.6	Implementability	8-30
8.7.7	Costs	8-31
9.0	COMPARATIVE ANALYSIS OF ALTERNATIVES	9-1
10.0	PREFERRED ALTERNATIVE	10-1
11.0	REFERENCES	11-1

LIST OF FIGURES

		<u>Following Page</u>
Figure 1-1	Site Location Map McLaren Tailings Site	1-1
Figure 1-2	McLaren Tailings Site Map	1-1
Figure 3-1	Test Pit and Boreholes Sample Locations.....	3-2
Figure 3-2	McLaren Tailings Impoundment Subsurface Fence Diagram	3-4
Figure 3-3	Typical North/South Cross Section of Tailings Impoundment.....	3-4
Figure 3-4	Typical East/West Profile of Tailings Impoundment.....	3-4
Figure 3-5	Surface Water, Stream Sediment & Groundwater Sample Locations	3-7
Figure 7-1	Proposed Borrow Area For Alternatives 4, 6, and 7	7-11
Figure 7-2	Alternative 4 Conceptual Design, New Channel Alignments.....	7-13
Figure 7-3	Soda Butte Creek/Miller Creek Typical Cross Section Reconstructed Channel	7-13
Figure 7-4	Soda Butte Creek/Miller Creek New Channel Reconstruction Details	7-13
Figure 7-5	Proposed Repository for Alternatives 5a, 5b, and 5c.....	7-17
Figure 7-6	Typical Repository Cross Sections	7-17
Figure 7-7	Alternative 5a Typical Encapsulated Repository Section.....	7-18
Figure 7-8	McLaren Tailings HEC-RAS Flood Analysis.....	7-20
Figure 7-9	Alternative 5b Typical Multi-Layered Cap Section.....	7-22
Figure 7-10	Alternative 5c Typical Repository Soil Cover Section	7-26

LIST OF TABLES

		<u>Page</u>
Table 3-1	Significant Surface Water and Sediment Concentration Increases McLaren Tailings	3-7
Table 3-2	Discharge Values and Contaminant Loadings in Soda Butte Creek McLaren Tailings	3-8
Table 3-3	Groundwater Concentrations McLaren Tailings.....	3-10
Table 4-1	Summary of Preliminary Federal Applicable or Relevant and Appropriate Requirements	4-2
Table 4-2	Summary of Preliminary State Applicable or Relevant and Appropriate Requirements	4-8
Table 5-1	McLaren Tailings Site Risk-Based Concentration for Contaminants of Concern for the Residential Scenario (Smith, 1999).....	5-3
Table 5-2	McLaren Tailings Site Risk-Based Concentrations for Contaminants of Concern for the Recreational Scenario (Tetra Tech, 1996).....	5-3
Table 5-3	McLaren Tailings Site Summary of Non-Carcinogenic Hazard Quotients (HQ) and Carcinogenic Risk Values for the Residential Land Use Scenario	5-4
Table 5-4	McLaren Tailings Site Summary of Non-Carcinogenic Hazard Quotients (HQ) and Carcinogenic Risk Values for the Recreational Land Use Scenario	5-5
Table 5-5	McLaren Tailings Site Downstream Contaminant Concentrations in Surface Water (µg/L) and Stream Sediment (mg/Kg).....	5-7

Table 5-6	McLaren Tailings Site Average Concentrations (mg/Kg) in Surface Sources ..	5-7
Table 5-7	McLaren Tailings Site Numerical Water Quality Criteria	5-8
Table 5-8	McLaren Tailings Site Hardness-Dependent Water Quality Criteria	5-8
Table 5-9	McLaren Tailings Site Sediment Quality Criteria (Proposed)	5-8
Table 5-10	McLaren Tailings Site Summary of Phytotoxic Soil Concentrations	5-9
Table 5-11	McLaren Tailings Site Ecologic Impact Quotients (EQs) for the Surface Water Aquatic Life Scenario	5-9
Table 5-12	McLaren Tailings Site Ecologic Impact Quotients (EQs) for the Sediment Aquatic Life Scenario	5-10
Table 5-13	McLaren Tailings Site Ecologic Impact Quotients (EQs) for the Plant Phytotoxicity Scenario	5-10
Table 5-14	McLaren Tailings Site Summary of Ecologic Impact Quotient (EQ) Values..	5-11
Table 6-1	Proposed Clean Up Goals for the McLaren Tailings Site.....	6-2
Table 6-2	Risk Reduction Necessary to Attain Non-Carcinogenic Human Health and Ecologic Clean Up Goals.....	6-2
Table 7-1	General Response Actions, Technology Types, and Process Options for Contaminated Solid Media at the McLaren Tailings Site.....	7-2
Table 7-2	Reclamation Alternatives for the McLaren Tailings Site	7-8
Table 7-3	Infiltration Reduction Provided by Alternative 5a (HELP Model Results)	7-20
Table 7-4	Infiltration Reduction Provided by Alternative 5b (HELP Model Results).....	7-24
Table 7-5	Infiltration Reduction Provided by Alternative 5c (HELP Model Results)	7-28
Table 7-6	Preliminary Evaluation and Screening of Alternatives	7-36
Table 8-1	Risk Reduction Achievement Matrix – Alternative 1.....	8-7
Table 8-2	Water Quality ARARs Attainment for Alternative 1.....	8-8
Table 8-3	Risk Reduction Achievement Matrix – Alternative 4.....	8-10
Table 8-4	Water Quality ARARs Attainment for Alternative 4.....	8-10
Table 8-5	Risk Reduction Achievement Matrix – Alternative 5a.....	8-14
Table 8-6	Water Quality ARARs Attainment for Alternative 5a.....	8-15
Table 8-7	Risk Reduction Achievement Matrix – Alternative 5b.....	8-19
Table 8-8	Water Quality ARARs Attainment for Alternative 5b.....	8-19
Table 8-9	Risk Reduction Achievement Matrix – Alternative 5c.....	8-23
Table 8-10	Water Quality ARARs Attainment for Alternative 5c.....	8-24
Table 8-11	Risk Reduction Achievement Matrix – Alternative 6.....	8-27
Table 8-12	Water Quality ARARs Attainment for Alternative 6.....	8-28
Table 9-1	Comparative Analysis of Alternatives	9-2
Table 9-2	Alternative Cost Effective Comparison Summary.....	9-5

LIST OF APPENDICES

Appendix A	Analytical Data for the McLaren Tailings Site Compiled by Pioneer Technical Services, Inc. (1993, 2000, and 2001)
Appendix B	McLaren Tailings Site Borehole Logs and Geotechnical Data 1989 Bureau of Reclamation Investigation
Appendix C	Photo Logs 2001 Pioneer Technical Services, Inc. Reclamation Investigation
Appendix D	Reclamation Alternatives Cost Tables for the McLaren Tailings Site

Appendix E	Description of Federal and State ARARs
Appendix F	HELP Model Output
Appendix G	Annotated Bibliography of Previous Research on Metal Loading in Soda Butte, Montana and Wyoming
Appendix H	HEC-RAS Modeling Results